Concrete Slab Over Living Space

Locating the garage on the main level requires sturdy framing and waterproofing details

BY TIM UHLER

Photos by Tim Uhler; illustration by Tim Healey

We recently framed a house on a sloped site with a walk-out basement and a garage on the main level. Instead of leaving the area underneath the garage unexcavated and pouring a slab on grade, we decided to take advantage of this real estate and create a roughly 24-by-24-foot living space below the garage slab. In this article, I'll describe the approach we took; keep in mind, we self-perform all of our framing and foundation work.

Engineering considerations. The slab and supporting structure needed to be able to support the weight of the materials and vehicles, but that's not all. The footings and foundation also would need to resist soil lateral loads on the 10-foot-tall foundation walls.

Floor design. We had already planned on using Roseburg I-joists for the home's floor system, and our engineer was able modify his design to support the slab using 11 7/8-inch I-joists 12 inches on-center that sat in joist hangers attached to a 5 1/4-by-11 7/8-inch RigidLam LVL located midspan. This LVL was then supported at each end by a 6x6 column with an expanded footing and by one column in the center of the room below the garage on a 36-by-36-by-12-inch footing. The subfloor itself is 3/4-inch AdvanTech. While we would have loved to eliminate the center column, the depth of the beam needed to provide an unsupported span would have presented headroom issues.

We framed this floor so that it was lower than the main-level

Shown here are the expanded footings for the columns and bearing walls that will support the framing underneath the garage slab, and the steel reinforcement for the 10-foot-high foundation wall **(1)**. Foam insulation was installed underneath most of the basement slab except over the footings that support point loads **(2)**. A 5 1/4-inch-by-11 7/8-inch flush beam that bears on midspan and end-span columns was installed to support loads from the slab and two cars **(3)**. The crew then hung 11 7/8-inch I-joists from the beam 12 inches on-center **(4)**. Note that the entire subslab floor system is dropped below the main-level floor system to accommodate the thickness of the garage slab.

floor by 6 inches so that the top of the slab could be roughly even with the entry into the house. We chose 6 inches so we could slope from that height to 4 inches in the front at the garage door opening for positive drainage away from the garage. Because the structural design was more than sufficient for the load, there was no reason to specify lightweight concrete.

The I-joists that support the slab are supported by 2x6 walls with studs spaced 12 inches on-center. Because the rear and side walls are shear walls and are anchored to footings, we sheathed them with 7/16-inch sheathing.

Foundation wall design. Across the front of the house, the foundation walls are 10 feet high and therefore have special reinforcing requirements (rebar), along with a footing design that supports not only these walls but also the walls we needed to build under the floor joists around the inside of the basement **(1, 2)**.

While the design featured 10-foot-tall basement walls, the top of the floor system needed to be flush with the top of the mudsill. This means that there is no rim joist along the front of the house; instead, to minimize the height coming into the house, there is only the top of the foundation wall. To execute this design, we had to frame bearing walls along the inside of the house's foundation walls to support the floor system **(3, 4)**.

The exterior walls above are bearing on the stem walls. This affected the footing design. The footings are 2 feet wide by 1 foot deep with three #4 rebar running the length of the footing. The footing is slightly biased toward the inside of the house to support

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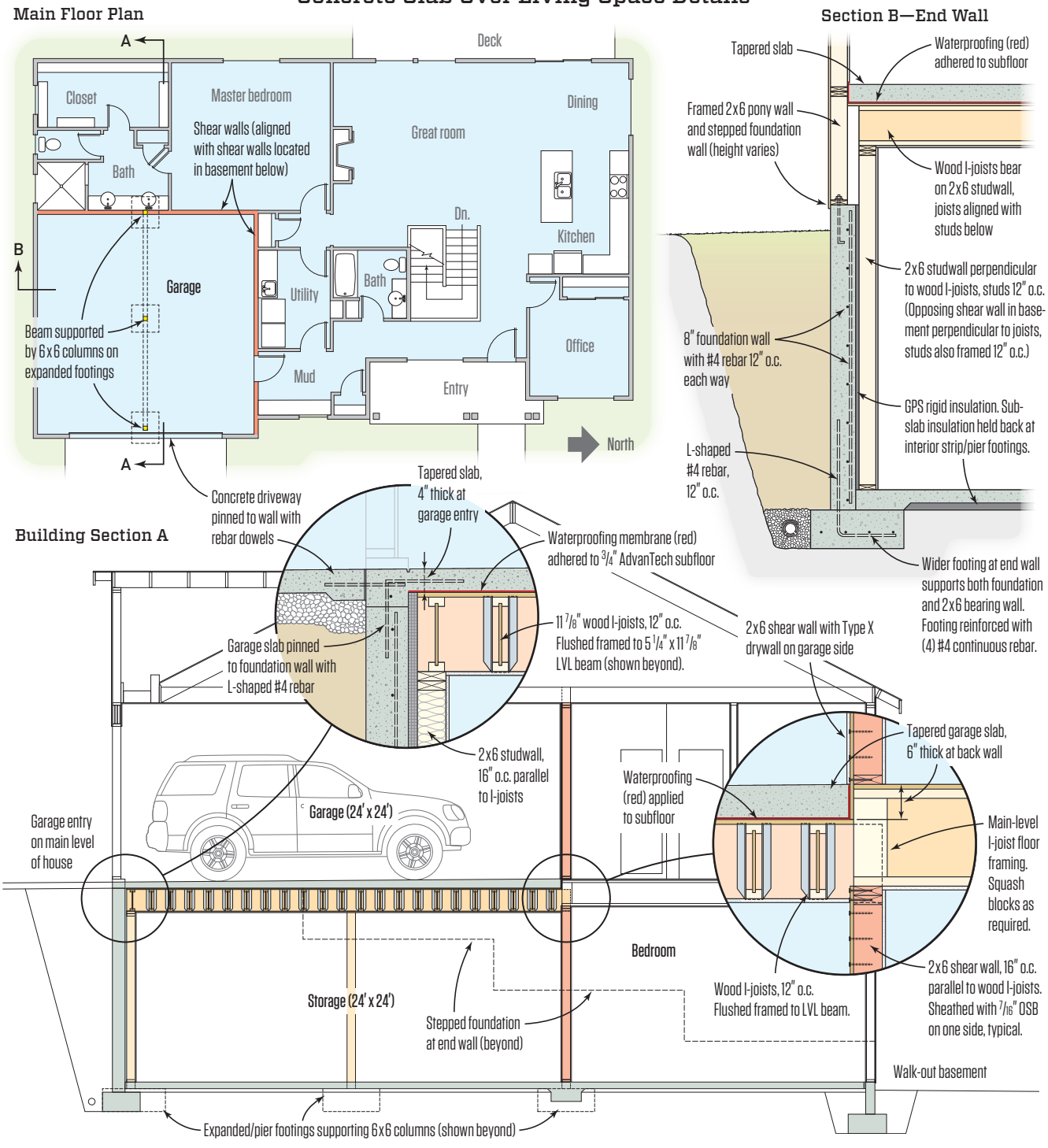

The engineered design for the main-level garage slab includes robust structural details to resist both vertical and lateral loads and a vapor-permeable membrane between the slab and subfloor sheathing. Shear walls are also part of the design.

The center column was needed to allow the rest of the ceiling below the slab to be flush-framed **(5)**. Here, a worker is installing one of the main-level I-joists above the walk-out portion of the basement at the back of the house **(6)**. The subfloor sheathing at the garage entry (see white arrow) will be cut back to allow the slab to be pinned to the foundation wall **(7)**. The shear walls on the main level were framed so that they are aligned with the shear walls underneath the garage slab **(8)**.

the basement slab and framed walls. On the north/south walls, running parallel to the joists, the footings are 2 feet 6 inches by 12 inches deep with four #4 rebar, again biased toward the interior 1 foot 3 inches. That had mostly to do with the joists running parallel to the foundation wall **(5–8)**.

Slab prep. This isn't the first time we've installed a garage slab over wood framing. I remember a few projects that we completed in the early 1990s with a similar detail, mainly because I had to tediously hand-nail joist hangers for tightly spaced 2x12 joists. On this job, we spent considerable effort raking debris out of the joints in the subfloor sheathing and then cleaning off the dust with a leaf blower **(9)**.

To protect the AdvanTech subfloor from the concrete slab on top of it, we used a highly vapor-permeable roofing underlayment called SlopeShield Plus SA (vaproshield.com), designed for mass-timber floor and roof decks. Similar to an ice-and-water-barrier product but vapor open (30 perms), SlopeShield is designed to block bulk-water intrusion but allow long-term drying of a roof or subfloor assembly through vapor diffusion.

SlopeShield measures 20 mils thick and comes in 59-inch-wide-by-102-foot-long rolls. It has a release film backing, and my brother and I were able to install it quickly. There is no need for a primer, and the pressure-sensitive adhesive allowed us to reposition the membrane as needed as we rolled it out and pulled off the release film. As recommended, we used a 100-pound vinyl-flooring roller (that

Before rolling out the subslab membrane, the author raked out the sheathing joints and blew the dust off the subfloor **(9)**. A heavy flooring roller was used to help adhere the SlopeShield Plus SA underlayment to the subfloor **(10)**. The 4,000-psi concrete for the slab was placed without rebar **(11)**. Contraction joints were strategically located, including over the joint where the slab thickness transitions from 10 inches over the concrete stem wall to 4 inches where the rest of the slab is supported by the wood subfloor **(12)**. The slab was given a steel trowel finish and tapers away from the entry into the house for a smooth transition **(13)**.

our flooring contractor let us borrow) to roll out the product; once we did, the membrane was permanently stuck to the subfloor. The roller is definitely a "must use" with this product **(10)**.

Concrete. No special prep was required for placing the concrete because the floor is flat and designed for the load. We use a 4,000-psi concrete mix, which we've confirmed with third-party testing at least twice over the years **(11)**.

We elected to go without rebar because it doesn't prevent cracking, and the underlying structure isn't going to be moving. Since all concrete eventually cracks, we discussed the locations of the contraction joints with our flatwork subcontractor to make sure any cracking that does occur looks intentional. It's important to break up the area with enough joints to prevent unintentional cracking elsewhere. He does an outstanding job tooling in the joints **(12)**.

The slab tapers from 6 inches thick at the back wall to 4 inches thick at the garage door opening for drainage (there is no center drain). For a flush, wheelchair-accessible transition, we created a slight taper in the slab between the garage slab and the entry from the garage into the house **(13)**.

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